

CLIMATOLOGY OF DESCHUTES VALLEY.

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THE RIVER.

The Deschutes River rises near the summit of the Cascade Mountains in Crescent Lake, Klamath County, Oreg. It is about 210 miles long, flows in a northerly direction and empties into the Columbia River at Deschutes, a small town 15 miles east of The Dalles, and 4 miles east of the Celilo Rapids. The basin is triangular in shape (as shown by the map, fig 1), being narrowest near the mouth of the river and broadest in the south, owing to the course taken by its principal eastern tributary, the Crooked River, which rises in the Blue Mountains and flows westerly for about half its length and then north-

3½ miles wide. The lakes at the head of West Fork are smaller than Crescent Lake, as are also those near the headwaters of Tumulo Creek, Squaw Creek, and Metolius River, but many of them have swampy surroundings, thus showing that these natural reservoirs have a larger storage capacity than indicated by the amount of water in sight.

The Deschutes River drops 4,840 feet from Crescent Lake to its confluence with the Columbia River, and on account of the uniformity of its flow, its power and irrigation possibilities are enormous. These are treated in the succeeding paper by Mr. J. C. Stevens, District Engineer of the Water Resources Branch of the United States Geological Survey, who has made a special study of the river in this connection. The accompanying views

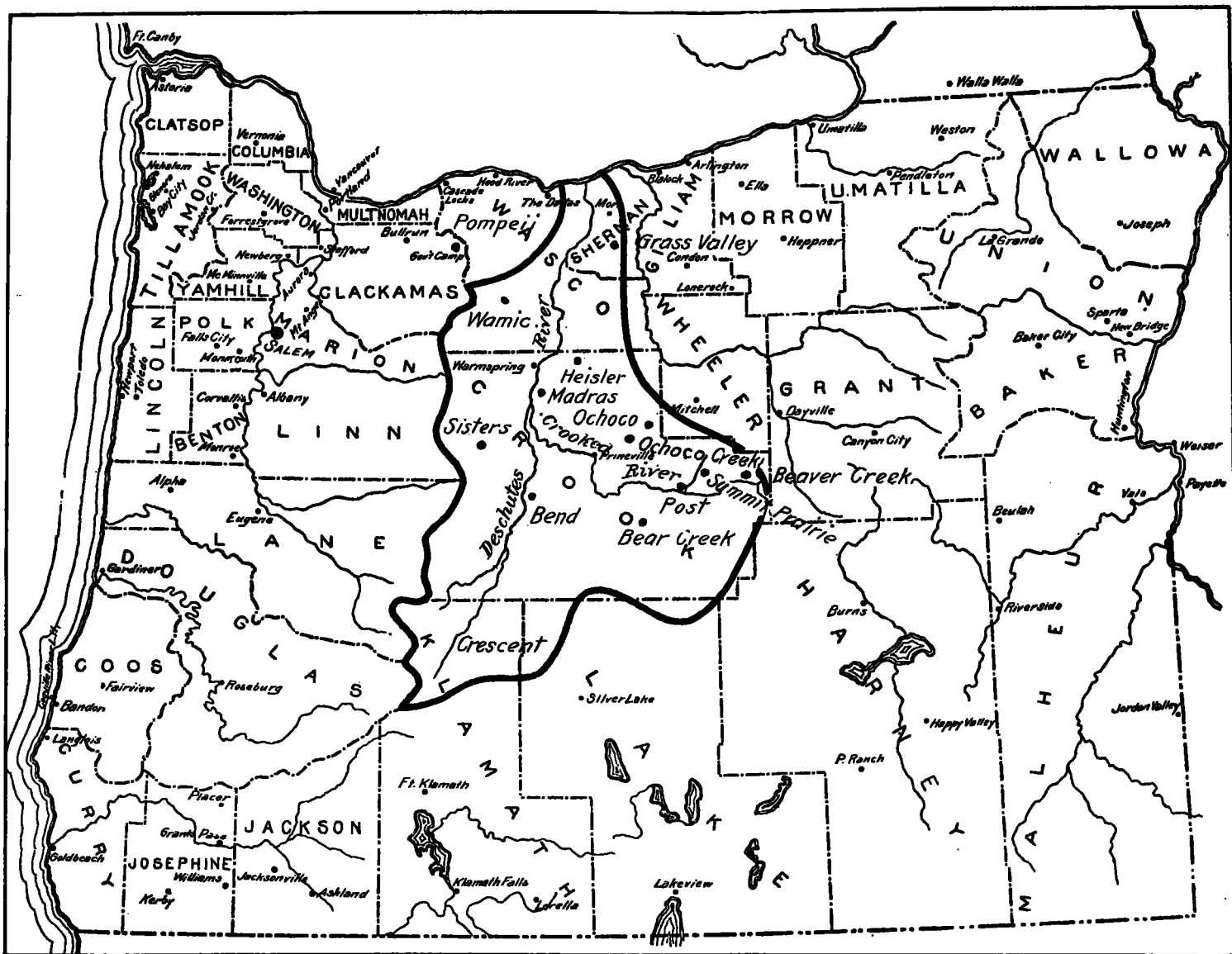


FIG. 1.—Drainage basin of the Deschutes River, Oreg., and names of places at which meteorological observations have been taken in that region.

westerly until it joins the main stream nearly opposite the southeastern corner of the Warm Springs Indian Reservation. Other important tributaries from the east are Trout and Willow creeks, both of which rise in the Blue Mountains and flow northwesterly and empty into the Deschutes River below the mouth of Crooked River. The principal western tributaries are West Fork, which rises in 4 small lakes in a high timbered country, and Tumulo Creek, Squaw Creek, Metolius River, and Warm Springs River. Crescent Lake, which is the source of the Deschutes River, is a fine body of water 6 miles long and

of the river have been loaned by Mr. John H. Lewis, State Engineer of Oregon.

TOPOGRAPHY.

The upper and broadest portion of the valley is a high plain, broken in places by ridges and hills, but on the whole quite level; the lower portion of the valley is very hilly. The Cascade Mountains on the west have an average elevation of 5,000 feet and they are crowned with several peaks that are covered with snow the year round; the most noted of which are, Mount Jefferson, Mount Washington, Three Sisters, Maiden Peak



FIG. 2.—The Deschutes River at Bend.



FIG. 3.—Cline Falls, on Deschutes River, Crook County.

Diamond Peak, and Cowhorn Peak. In the south, near the source of the main stream, is the Walker Range, an eastern spur of the Cascade Range, and to the northeast and east are offshoots of the Blue Mountains, known as the Paulina Mountains, Maurey Mountains, Grizzley Mountains, etc. The offshoots from the Blue Mountains are not so high as the Cascade Mountains, but many of their peaks reach altitudes of 2,000 feet, or more, above the plains below. The divide between the Deschutes and John Day rivers for a distance of 50 miles south of the Columbia River, is a rolling country, with many hills, but none high enough to be classed as mountains.

SOIL.

The soil is composed of disintegrated lava and is commonly called volcanic ash. It is similar to that covering a large area in the central portion of the Columbia River Valley and it has slowly accumulated through the weathering of the great sheets of lava that overflowed northern Oregon and central Washing-

Indian Reservation southward to California. It widens southward, reaching the banks of the Deschutes River, near Bend (see fig. 2), and gradually spreads eastward to the upper limits of the basin. The average width of this forest is about 50 miles and its length is about 150 miles.

There is very little underbrush in the forests in the Deschutes Valley, so that one can go on horseback through them in any direction without having to change one's course on account of undergrowth obstructing the path taken. Forests similar to the one just described, except that they are smaller in area, cover the slopes of the Paulina, Maurey, and Grizzley mountains. About half of the forests is owned by corporations and private persons, and the other half has been withdrawn from public sale and put in the hands of the United States Forest Service for administrative purposes.

The bunch and rye grasses on the plains furnish feed for thousands of head of cattle, horses, and sheep, many of which



FIG. 4.—Deschutes River at Sherar's bridge.

ton during the Miocene period. South of Cline Falls, fig. 3, much of the lava is soft and porous, instead of being hard and brittle, and the disintegrated scoria have become a pumice soil capable of retaining a large amount of water. This water seeps into the river beds slowly with little variation from day to day. The soil although fertile is not uniformly deep and there are many places where the bed rock comes to the surface.

VEGETATION.

There are comparatively few barren areas in this region such as are found in the Colorado desert, and the entire basin is covered by a natural growth of some kind. The slopes of the mountains are forested and the plains are dotted with Juniper trees and covered with sage brush, bunch grass, etc. The most common tree in the mountains is the yellow pine (*Pinus ponderosa*) and on the plains the juniper (*Juniperus occidentalis*). The latter makes excellent fence posts and the former furnishes a fine grade of lumber that can be used for almost any purpose. The largest belt of timber extends from the Warm Springs

are kept on the plains in winter, and in the mountains during the summer months, or until the snow covers the feeding grounds in the fall. Very little farming has so far been done, but it has been proven that both the climate and the soil are favorable for raising grain, alfalfa, vegetables and, in certain localities, fruit.

HISTORICAL AND DESCRIPTIVE.

The first white people to explore the Deschutes Valley were those under the command of Col. John C. Fremont in 1843. This party left The Dalles in November and traveled south to California. They passed through the Deschutes Valley, and the Walker Mountains were named by Colonel Fremont after the army officer who directed him to make the journey. Irrigation in a small way has been carried on in the neighborhood of Prineville for many years, but no attention was given to this subject in other parts of the valley until about 8 years ago when extensive projects under the Carey Act were started in the neighborhood of Bend. There are now several thousand acres

of land in the Deschutes Valley being irrigated and more will soon be ready. The principal ditches now in operation are the Finley Ditch near Rosland, the Central Oregon, Pilot Butte, and Columbia Southern ditches near Bend, and the Carmichael Ditch at Prineville. To those who wish to live on the land and cultivate it thousands of acres are open to settlement, and it is expected that in a short while the large sheep and cattle ranches will be a thing of the past, and that small farms devoted to the raising of grain, alfalfa, and vegetables will take their place.

believed that further extensions will be made as soon as the portions now contracted for have been completed.

The Warm Springs Indian Reservation containing 725 square miles is wholly within the Deschutes Basin. The soil on this reservation is rich and produces an abundance of grain, grasses, and vegetables. At the time of the last census there were 837 Indians living on the reservation and 37 farms were being cultivated. The majority of these farms had from 20 to 80 acres under cultivation and the crops were reported as being very good. The country surrounding Madras is much like

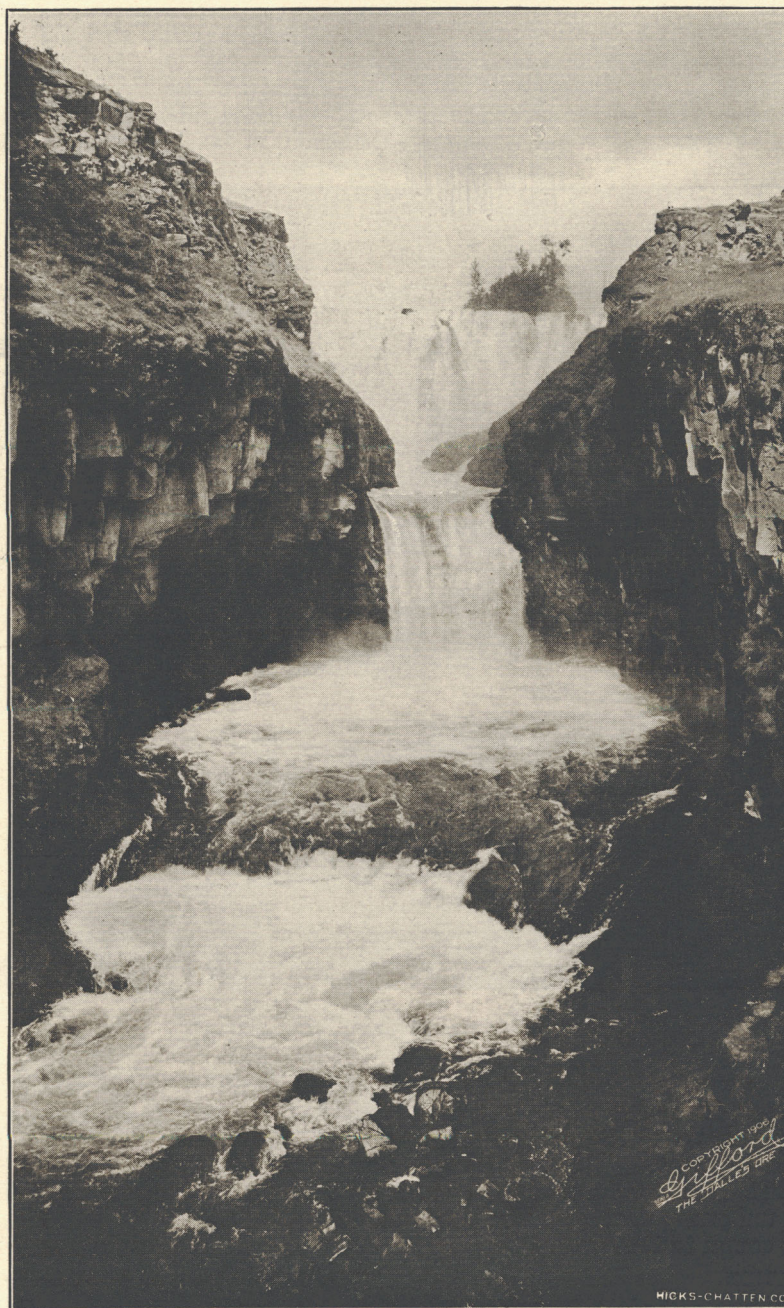


FIG. 5.—White River Falls, in lower Deschutes Valley.

Two railroads are now being built up the valley from the Columbia River; the objective point of one being Madras and the other Redmond. Another railroad is being built over the Cascade Mountains which will pass through the northern end of the Deschutes Valley, and run from there to Klamath Falls. All 3 of these railroads are branches of great systems, and it is

that on the Warm Springs Agency Plains; its elevation is between 2,200 and 2,400 feet above sea level, and bunch grass and sage brush are found in large quantities. To the southeast of the "Madras Plains" are the "High Plains" about Prineville, which have long been known as the feeding place for great numbers of cattle, horses, and sheep. Prineville is a

thriving city of about 1,500 inhabitants, and is the distributing point for a large portion of the surrounding country. In the southern end of the valley is a section about 25 miles long and 6 miles broad known as Walker Basin. This section is covered with a growth of small pines, and the raising of stock has so far been the principal occupation of the few inhabitants in that locality.

Besides Prineville and Madras, other important towns are Redmond, about 100 miles south of the Columbia River; Bend, on the main stream about 115 miles from its mouth in an air line; Rosland, 35 miles south of Bend, and Crescent (formerly called Odell), in the upper end of the valley, about 155 miles from the Columbia River, and 90 miles from Klamath Falls. Telephone lines connect all these settlements and towns with railway points, and there is no question but this country, which is larger than the State of New Jersey, offering such exceptional advantages from an agricultural and manufacturing standpoint, will soon become well populated and the seat of numerous industrial activities.

CLIMATIC CHARACTERISTICS.

The records from 18 stations are used in this discussion; 3 of these stations, viz: The Dalles, Grass Valley, and Silver Lake, are not in the Deschutes Basin, but they lie so near its border that they reflect fairly well the conditions in the valley itself. Another station, Pompeii, is on the divide between the Deschutes and the Willamette valleys. Of the remaining stations, there are only 4 having records extending back 5 or more years; therefore, it has been necessary, in order to reach any understanding whatever of the climatic conditions over large areas, to make use of the records from a number of stations that have been in operation only a short while.

In general the climate is dry, and subject to great extremes of temperature; there is an abundance of sunshine and for that reason, as well as on account of the dryness of the air, the extremes of temperature are not so noticeable as they otherwise would be. In the heart of the valley the temperatures sometimes go below the freezing point in midsummer, but they do not remain below this mark, as a rule, long enough to injure hardy vegetation; however, when a temperature of 26° is reached damage ensues, and the interval between the last temperature of 26° in the spring and the first in the fall constitutes the growing season for the staple crops raised in the valley. This season usually begins the middle of May and lasts until the middle of September. The prevailing winds are southwesterly, with a tendency to veer to the west, or even northwest, at times during the summer months.

TEMPERATURE.

The mean temperature for the entire valley, as obtained from all available records is 48°; the warmest month is July, with a mean of 67°, and the coldest is January, with a mean of 31°. The range between the mean temperature of the warmest and the coldest months is about 36°, which is less than that in the northern States east of the Rocky Mountains. The warmest part of the valley is near the mouth of the river, where the mean temperature is 52°, from which point it decreases in going up stream to about 44° near the mouth of the West Fork, and to 42° at the summit of the main range of the Cascade Mountains. In the Crooked River Valley, at Prineville, the mean temperature is 48°, and at Warm-spring it is 51°.

The highest temperature ever recorded in this valley is 112° at Wamic, and the lowest 32° at Warm-spring. In the summer months temperatures of 90° are not uncommon in all parts of the valley, except high up on the slopes of the mountains, where the thermometer seldom, if ever, registers 80°. Sometimes the temperature rises above 100°, but such great heat is rare and does not last long. There are, usually, short spells every winter with zero temperatures, and weather of this character may occur in December, January, or February, but seldom is

so low a mark reached in November or March, although in these months it has been that cold on a few occasions.

PRECIPITATION.

The precipitation in the bottom of the valley averages about 12 inches, and increases rapidly with elevation, being about 86 inches at the summit of the Cascade Mountains, in the north, and about 20 inches near the summit of the mountains on the east side of the river. The rainfall increases slightly also near the bottom of the valley, in going up stream, being about 10 inches near the mouth of the river, nearly 12 inches at Warm-spring, 16 inches at Bend, and 19 inches at Crescent. The precipitation is heaviest in the 3 winter months, and lightest in July and August. There is a secondary maximum in May and June, which is welcomed as it comes at the season of the year when the crops need the most moisture. This secondary maximum in rainfall is not very pronounced, but it is plainly shown in the records from Grass Valley, Prineville, Bend, Crescent, and Silver Lake. The average number of days with 0.01 of an inch, or more, of precipitation each year is about 68, and in a general way the number of rainy days follows the distribution of the rainfall, being least at the lower end of the valley, and increasing in going up-stream, as well as in going up the sides of the mountains on either side of the river.

About 23 per cent of the precipitation occurs in the form of snow, which may fall in small quantities as early as November, but is heaviest in January. The snow cover generally disappears sometime in March, although in the upper portion of the valley snow sometimes falls in April, and light falls have occurred in May; rarely, however, is there any snow in October. The snow does not cover the ground continuously throughout the winter in the bottom of the valley, but it does at moderate heights on the slopes of the mountains.

THUNDERSTORMS.

The first of the season's thunderstorms generally occur in April, and during the 4 succeeding months there is usually one or more recorded each month throughout the valley, while, in the lower portion, the period of electric storms is often extended into or through September. The greatest number occur in June and July over most of the valley, with an apparent tendency toward the greatest frequency in June in the northern half, while over the southern half the greatest number have been recorded in July. There is an occasional thunderstorm in October, November, or December, but these are extremely rare.

TABLE 1.—Monthly and annual precipitation.
BAKE OVEN, WASCO COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1892						0.44	0.64		0.32		1.08	1.70	
1893	0.60	0.20	1.20	2.20									

BEAR CREEK, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1909	2.18	1.53	0.97	0.17	0.84	0.54	1.55	0.00	1.06	0.84	2.44	1.35	13.50

BEAVER CREEK, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1908											0.80*	0.42	
1909	2.23	1.31	0.57	0.25	0.65	0.62	1.24	0.00					

* First 7 days missing.

BEND, CROOK COUNTY (latitude, 44° 4' N; longitude, 121° 17' W; elevation, 3,629 feet.)

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1901													
1902	0.63	2.05	0.65	0.83	0.90	T.	0.51	0.12	0.10	0.19	2.09	2.83	10.90
1903	3.46	0.35	1.02	0.02	0.05	1.95	0.42	0.20	0.02	0.33	4.94	0.61	13.37
1904	1.52	4.27	3.30	2.43	0.43	0.30	1.32	0.33	0.28	0.74	0.42	1.86	17.10
1905	2.83	0.74	2.39	0.29	1.99	1.29	0.31	0.00	0.41				
1906	0.97	1.25	1.25	0.07	1.45	1.68	0.55	T.	0.31	0.26	1.86	0.77	10.42
1907	6.34	4.00	2.33	1.30	1.42	1.79	0.23	1.44	0.96	0.40	0.76	4.78	25.75
1908	1.59	1.12	4.92	0.86	0.41								
1909									1.50	0.46	4.67	1.76	
Mns.	2.48	1.97	2.27	0.83	0.95	1.15	0.56	0.35	0.51	0.40	2.46	2.10	16.03

*Interpolated.

TABLE 1.—Monthly and annual precipitation—Continued.

CRESCENT, KLAMATH COUNTY (latitude, 43° 27' N; longitude, 121° 42' W; elevation, 4,452 feet).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1905	2.54	.....	.....	.....	1.65	0.34	0.07	T.	0.39	0.69	0.66	0.88	.....
1906	2.70	2.33	1.91	0.61	2.68	2.23	2.07	T.	0.42	0.74	1.92	2.85	20.29
1907	4.70	4.40	3.13	1.50	2.71	0.53	0.65	1.37	1.26	0.49	2.65	6.09	29.47
1908	1.56	1.00	1.16	0.82	0.58	0.54	0.31	0.19	0.25	3.61	1.49	1.03	12.54
1909	7.73	2.96	0.94	0.07	0.78	.....	1.12*	0.00	.....	.....	.....	.....	.....
Mns.	4.13	2.67	0.75	0.75	1.68	0.87	0.84	0.31	0.78	1.38	1.68	2.71	18.55

*Interpolated.

GRASS VALLEY, SHERMAN COUNTY (elevation, 2,381 feet).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1889	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.52	0.56	0.93	.....
1890	1.62	4.95	1.11	0.34	.....	.....	.....	.....	.....	.....	.....	.....	.....
1891	.....	.....	.....	.....	.....	.....	0.07	0.00	.....	.....	.....	.....	.....
1902	1.95	T.	0.57	0.50	0.04	1.94	0.20	1.40	0.65	0.60	2.15	1.10	11.10
1903	0.15	.....	.....	.....	.....	.....	0.09	T.	0.25	1.11	0.77	0.78	.....
1904	0.76	0.20	0.05	0.03	1.70	1.30	0.36	T.	0.75	1.36	0.85	1.35	8.71
1905	1.00	0.85	1.65	0.10	1.05	1.85	T.	0.34	0.35	T.	2.59	2.22	12.00
1906	2.65	0.48	1.60	1.06	0.90	0.89	0.30	0.71	0.50	0.20	1.48	2.68	13.43
1907	0.55	0.02	0.68	0.11	1.41	0.37	0.22	0.34	0.12	1.11	1.12	.....	.....
1908	2.56	1.03	0.68	0.10	0.49	0.99	0.10	0.02	0.45	0.87	3.34	1.14	11.77
1909	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mns.	1.40	1.08	0.91	0.32	0.93	1.22	0.18	0.36	0.38	0.69	1.57	1.56	10.60

HEISLER, CROOK COUNTY (elevation, 1,870 feet).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1905	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.28	0.45	.....
1906	0.97	0.49	1.41	0.38	0.74	1.32	1.13	T.	0.33	0.10	0.70	1.06	8.72
1907	1.92	2.21	1.95	0.50	1.44	.....	2.12	0.03	0.20	0.07	3.25	.....	.....
1908	0.50	0.35	0.15	0.21	0.15	0.60	0.38	.....	.....	.....	.....	.....	.....
1909	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mns.	1.13	1.02	1.17	0.38	0.78	0.96	0.76	1.06	0.18	0.15	0.38	1.59	9.56

MADRAS, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1909	1.29	0.32	T.	0.47	0.46	0.30	T.	2.03	0.55	2.17	2.40	.....

OCHOCO CREEK, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1908	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.76	.....
1909	3.00	2.01	0.79	0.32	0.71	0.61	1.00	0.00	1.71	1.16	4.43	2.56	18.30

POMPEII, CLACKAMAS COUNTY (elevation, 3,879 feet).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1896	14.02	14.16	13.93	13.29	15.36	3.33	0.00	2.98	1.95	5.25	25.31	14.77	124.35
1897	6.30	17.49	16.37	5.50	2.88	5.91	4.14	1.20	3.80	4.36	18.76	17.09	103.80
1898	11.46	12.94	6.19	4.49	3.69	3.01	1.52	0.80	6.89	4.71	19.83	12.10	87.93
1899	20.79	22.22	13.28	12.70	8.47	3.68	0.52	7.56	3.20	10.23	11.60	10.10	124.35
1900	10.25	12.33	7.78	5.04	5.99	4.80	0.79	3.31	5.81	11.98	6.05	6.79	80.92
1901	11.05	8.40	8.40	6.03	2.45	6.64	0.70	0.48	5.70	2.59	6.37	9.77	68.58
1902	5.54	6.85	10.27	5.23	7.24	1.54	5.71	1.35	4.23	3.75	18.13	13.47	83.30
1903	11.61	3.30	3.71	5.12	5.46	3.56	3.08	2.54	6.35	7.79	15.04	6.30	73.86
1904	13.03	14.93	12.01	3.63	2.73	3.07	1.78	1.02	1.25	4.65	9.34	12.07	79.50
1905	4.86	2.87	7.43	1.62	7.68	3.74	0.67	1.82	7.41	11.03	5.83	10.45	65.41
1906	6.19	4.26	2.66	1.80	4.62	6.24	T.	0.40	5.86	10.61	22.57	7.41	72.32
1907	10.75	8.00	5.13	7.35	1.81	3.80	0.73	3.11	2.984	1.81	11.03	12.84	69.04
1908	7.07	6.73	15.41	4.35	7.81	5.94	1.03	3.05	0.59	10.1	5.12	8.47	75.56
1909	13.57	11.06	6.36	6.17	5.09	1.01	4.73	0.83	5.43	6.01	24.75	8.30	93.30
Mns.	10.46	10.40	9.21	5.88	5.56	3.80	1.98	2.17	4.39	6.31	13.98	11.46	85.60

SILVER LAKE, LAKE COUNTY (latitude, 43° 8' N; longitude, 121° 3' W; elevation 4,700 feet).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1889	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1890	1.03	2.74	1.04	0.34	.....	.....	.....	.....	.....	.....	.....	.....	.....
1891	0.62	3.08	0.77	1.46	2.65	2.24	1.63	0.10	0.40	0.20	1.50	1.45	16.11
1892	0.12	0.91	2.40	0.77	2.52	.....	.....	.....	.....	.....	.....	.....	.....
1893	1.50	0.75	1.09	0.93	.....	.....	.....	.....	.....	.....	.....	.....	.....
1894	.....	.....	.....	.....	3.06	0.82	.....	.....	.....	.....	.....	.....	.....
1895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1896	.....	0.09	.....	1.89	0.64	0.30	0.13	0.39	0.18	0.40	2.32	.....	.....
1897	0.25	0.35	0.80	0.25	1.91	2.65	0.07	0.00	0.30	0.23	0.13	1.47	8.50
1898	0.27	0.30	0.15	0.23	1.87	0.76	0.20	0.05	0.20	0.56	2.03	0.38	6.99
1899	1.40	0.24	2.57	1.03	0.49	T.	0.00	0.40	0.37	1.44	0.75	1.68	10.36
1900	0.80	T.	0.31	0.53	0.90	0.42	T.	0.45	0.49	2.09	0.40	0.95	7.34
1901	0.08	1.69	0.30	0.10	0.34	0.04	.....	.....	1.09	1.31	0.57	.....	.....
1902	0.24	1.45	0.25	2.27	0.67	T.	.....	.....	.....	.....	.....	2.16	.....
1903	1.73	0.55	1.15	.....	0.52	0.72	.....	.....	.....	.....	.....	.....	.....
1904	.....	.....	.....	0.98	0.65	0.54	1.60	0.00	.....	0.56	0.55	.....	.....
1905	.....	.....	.....	1.03	0.70	1.43	2.33	0.05	0.00	1.34	0.55	0.23	0.07
1906	1.98	0.55	1.89	0.38	2.18	1.08	0.64	0.73	.....	0.87	0.77	0.32	1.68
1907	1.11	2.04	3.23	0.52	2.17	0.89	0.51	1.28	0.87	0.77	0.38	2.10	15.64
1908	0.00	0.09	0.27	.....	0.37	2.08	0.80	0.13	0.45	1.31	0.30	0.40	.....
1909	3.50	0.98	1.07	0.10	0.34	1.43	0.43	0.00	0.89	0.65	3.28	0.70	13.37
Mns.	0.98	0.99	1.14	0.78	1.34	1.02	0.50	0.30	0.61	0.90	1.00	1.30	10.86

SUMMIT PRAIRIE, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1909	4.72	1.96	0.66	0.23	1.31	0.36	1.98	.....	1.29	1.18	4.26	.....	.....

TABLE 1.—Monthly and annual precipitation—Continued.

THE DALLES, WASCO COUNTY (elevation, 112 feet).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l.
1850							0.01	0.00	0.09	0.91	1.14	0.19	.....
1851	3.81	1.70	1.78							0.25	2.75	8.01	.....
1852										0.24	4.90	0.95	14.48
1853	3.02	1.09	0.27	1.29	0.62	0.00	0.58	0.61	1.41	0.24	1.41	2.50	12.39
1854	2.79	0.73	0.36	1.52	0.00	0.15	0.00	0.18	0.84	1.91	1.41	2.50	12.39
1855	3.03	0.63	1.87	0.17	1.08	0.24		0.00	0.69	0.15	1.44	2.24	.....
1856		0.54	0.91	0.79									10.79
1857	7.08	1.85	2.83	0.00	0.23	1.02	0.08	0.00	2.70	0.25	5.38	7.42	29.34
1858	5.60	9.41	2.91	1.36	1.70	1.03	0.00	0.75	5.16	3.32	6.48	5.93	43.65
1859	5.33	6.00	6.07		1.27	0.20	0.06	0.47	5.77	2.14	4.25	3.66	.....
1860	5.30	2.00	1.33	0.83	1.73	0.59	1.38	0.40	0.35	0.48	3.46	3.47	21.32
1861	2.68	3.26	1.59	1.46	1.34	2.08	0.00	0.14	0.33	0.75	6.97	8.25	28.85
1862	4.47	2.25	3.54	0.20	2.61	1.03	0.22	0.07	0.64	0.43	0.20	0.63	16.29
1863	3.38	2.17	0.62	0.48	0.65	0.11	0.88	0.08	0.30	0.48	0.74	4.11	14.00
1864	5.88	0.22		0.20	0.09	0.36	0.00	T.	0.16	0.27	1.44	2.95	.....
1865		1.66	1.52	0.06	0.00	0.08	0.55	0.57	0.59	2.06	6.37	2.55	.....
1866	6.35	2.83	5.56										.....
1875	4.17	0.31	2.13	0.59	0.51	1.63	0.14	0.12	0.72	4.80	6.18	4.50	26.40
1876	2.76	1.39	2.20	1.09	0.20	0.34	0.07	0.02	0.13	2.37	4.31	0.46	15.34
1877	0.78	1.68	3.66	1.21	1.03	0.15	0.28	0.10	1.24	1.66	4.18	1.56	17.53
1878	2.96	2.32	1.99	0.	0.26	C.02	0.08	0.13	1.01	1.53	1.42	1.61	13.53
1879	1.42	6.32	3.15	1.34	2.94	0.11	0.31	0.48	0.79	0.88	1.24	2.57	21.65
1880	2.04	1.33	0.16	1.03	0.94	0.02	0.02	0.43	0.08	0.12	0.69	6.75	13.61
1881	6.37	6.23	0.38	1.29	1.14	1.82	0.11	0.23	0.26	0.26	0.75	1.67	21.92
1882	1.48	2.96	0.23	0.53	0.27	0.90	0.12	0.72	0.43	2.30	0.75	5.14	15.53
1883	4.83	0.61	2.32	1.21	0.54	0.01	0.00	0.20	0.01	0.46	2.19	1.77	14.15
1884	1.33	3.10	0.74	1.33	0.04	0.93	0.44	0.12	0.65	1.27	0.82	7.04	17.81
1885	1.10	2.88	0.14	0.31	0.81	1.01	0.10	0.03	0.87	0.28	1.78	2.64	11.95
1886	5.45	0.53	0.93	0.30	0.11	0.07	0.19	0.02	0.14	0.81	0.21	5.04	18.80
1887	4.01	0.13	0.79	0.46	0.32	0.67	0.07	0.18	0.36	0.15	1.06	3.01	12.21
1888	3.36	0.41	0.94	0.05	0.70	0.92	0.29	0.00	0.02	0.95	1.34	2.71	11.69
1889	0.51	0.04	1.26	0.42	0.66	0.28	T.	T.	0.16	0.90	1.27	2.00	7.51
1890	2.97	4.33	1.89	0.14	0.03	0.27	0.06	0.04	0.11	1.16	0.00	1.19	12.18
1891	1.13	2.47	0.53	0.01	0.32	0.51	0.24	0.11	0.13	1.14	1.39	4.14	12.12
1892	1.35	0.68	0.70	1.00	0.67	0.06	0.27	T.	0.14	0.90	1.16	5.04	11.97
1893	0.69	1.84	0.66	1.69	0.69	0.06	0.30	0.00	1.21	4.40	4.36	1.77	17.97
1894	4.84	1.83	3.73	0.64	0.47	1.15	0.10	T.	1.02	2.08	0.51	1.65	18.02
1895	4.72	0.47	0.65	0.24	0.94	0.00	0.32	0.05	1.14	0.00	1.20	4.15	13.88
1896	3.45	0.72	1.00	0.95	0.63	0.10	T.	T.	0.28	0.42	0.60	5.87	2.74
1897	1.14	2.98	1.94	0.23	0.27	1.07	0.24	0.08	0.54	0.44	3.84	4.03	16.80
1898	0.82	0.98	0.30	0.11	0.03	0.90	0.17	0.02	0.85	0.13	2.13	1.14	7.58
1899	2.82	2.19	0.94	1.05	0.45	0.20	0.00	0.56	0.81	1.56	3.57	2.29	10.74
1900	1.90	1.94	1.62	0.42	0.03	0.47	T.	T.	0.55	1.09	2.02	2.25	13.33
1901	3.46	4.15	0.68	0.09	0.39	0.20	T.	T.	0.16	1.84	0.13	1.69	15.83
1902	1.61	3.79	0.52	1.82	0.63	0.13	0.26	0.00	0.36	0.78	3.53	4.00	17.43
1903	2.87	0.47	0.56	0.23	0.05	2.11	0.12	0.11	0.15	1.10	4.44	0.56	12.77
1904	1.52	4.50	3.10	0.98	0.09	0.46	0.40	0.04	0.61	1.44	1.01	1.79	19.94
1905	3.27	0.51	0.63	0.18	0.96	1.27	0.19	0.10	1.19	1.38	0.54	1.07	11.79
1906	1.90	1.67	1.21	0.11	0.95	1.05	T.	T.	0.31	0.35	0.23	3.98	3.07
1907	3.92	3.08	1.30	1.67	0.41	0.42	0.22	T.	0.74	0.29	0.29	2.22	5.52
1908	1.06	0.77	1.50	0.17	0.92	0.10	0.36	0.16	0.03	0.42	0.43	1.21	8.18
1909	2.90	1.41	0.33	0.08	0.13	0.13	0.39	0.00	1.05	0.83	4.55	3.09	14.99
Mns.	3.12	2.17	1.56	0.68	0.63	0.56	0.21	0.21	0.82	1.17	2.53	3.30	16.96

TABLE 1.—Monthly and annual precipitation—Continued.

POST, CROOK COUNTY.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l.
1908													
1909	2.23	1.36	0.78	0.12	0.92	0.85	0.68	0.00	1.06	0.85	2.27	0.91	12.03

WARMSRING, CROOK COUNTY (latitude, 44° 46' N; longitude, 121° 35' W; elevation, 1,600 feet.)

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l.
1902					0.55	0.04	0.47	0.11	0.01	0.30	1.02	2.34	
1903	2.37	0.27	0.80	0.26	0.23	0.65	0.10	0.21	0.04	0.38	3.09	0.23	8.63
1904	0.50	3.08	3.46	1.88	0.37	0.06	2.35	1.95	0.28	0.85	0.27	1.21	18.26
1905	2.01	0.59	0.92	0.42	1.27	0.77	0.53	T.	1.40	1.16	0.17	0.68	9.92
1906	1.25	1.02	2.21	0.23	0.77	1.36	0.36	0.00	0.14	T.	0.98	1.07	9.39
1907	3.31	2.83	1.59	0.70	0.83	0.49	0.38	0.66	0.12	0.20	0.74	4.33	16.18
1908	0.36	0.43	1.53*	0.20	0.93	0.40	0.75	0.60	0.43	1.68	0.81	0.40	8.52
1909	3.12	0.94	0.21	0.00	0.74	0.87	0.22	0.00	1.15	0.62	2.96	1.93	12.76
Mns.	1.85	1.31	1.53	0.53	0.71	0.58	0.64	0.44	0.45	0.65	1.26	1.52	11.47

* Interpolated.

TABLE 2.—Mean temperature.

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	9	30.9	34.0	36.8	43.4	49.0	55.2	62.7	62.1	53.7	49.3	20.2	31.9	44.8
Grass Valley	7	28.8	33.5	40.4	45.2	49.5	56.1	64.0	62.1	55.4	48.2	38.9	31.2	46.1
Heisler	3	32.9	38.7	42.6	49.9	54.0	61.1	71.9	66.0	60.5	50.5	40.0	38.0	50.5
Prineville	12	33.2	36.1	40.5	46.5	53.1	58.2	64.8	63.3	57.0	49.9	41.7	36.0	48.4
Silver Lake	15	28.3	31.4	35.7	42.8	48.8	55.6	64.6	60.9	53.6	45.2	36.8	29.8	44.5
The Dalles	34	32.6	34.2	46.0	53.5	60.6	66.4	72.6	70.8	62.6	52.3	42.2	36.0	52.5
Wamie	6	32.1	34.8	40.7	48.0	52.4	59.7	66.3	64.1	58.3	51.0	41.3	32.1	47.6
Warspring	8	32.8	37.3	42.8	49.9	54.9	62.2	69.9	68.7	60.9	51.7	42.0	33.8	50.6

TABLE 3.—Highest temperatures by months.

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	8	59	66	73	84	93	93	103	98	92	86	69	61	102
Grass Valley	8	58	66	70	82	90	91	106	99	98	85	72	56	106
Heisler	4	58	67	72	92	89	99	105	100	97	88	71	63	105
Prineville	13	76	73	83	92	96	98	105	99	93	89	82	76	105
Silver Lake	15	69	70	83	86	94	94	104	101	95	91	77	66	104
The Dalles	35	65	69	78	88	98	103	105	108	101	88	73	66	108
Wamie	8	61	69	72	84	89	98	105	112	97	85	81	56	112
Warspring	8	60	63	72	90	94	101	109	105	97	90	75	63	109

TABLE 4.—Frost data.

Stations.	Length of record.	Average date of first killing frost in autumn.	Average date of last killing frost in spring.	Earliest date of killing frost in autumn.	Latest date of killing frost in spring.
Bend		September 2	January 8	August 14	January 27
Grass Valley	7	September 21	May 20	August 11	January 13
Heisler	3	October 1	May 3	September 11	May 17
Prineville	13	September 17	May 28	August 18	June 26
Silver Lake	13	August 23	January 16	July 17	January 30
Sisters					
The Dalles*	34	November 5	April 10	September 26	May 12
Wamie	7	October 12	May 1	September 23	May 20
Warspring	7	September 2	May 16	September 11	June 14

*Temperature of 32°, or below, used.

NOTE.—In cases where the records do not show actual frost temperatures of 26° or below have been used, as this temperature appears to be the critical one for the staple crops in the bottom lands, and hardy vegetation does not suffer greatly unless the temperature reaches 26° or goes below that mark.

The above table should not be used for comparison of frost data with similar data from other sections of the country where a temperature of 32° has been used as a limiting basis for determining the occurrence of frost, instead of 26°, as indicated above.

TABLE 5.—Lowest temperatures by months.

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	8	-19	-19	-13	8	11	23	28	26	12	14	-4	-11	-19
Grass Valley	8	-30	-17	-4	16	11	25	31	23	20	15	-7	-1	-30
Heisler	4	-19	-6	0	16	23	27	40	29	28	15	13	11	-19
Prineville	13	-29	-17	-1	12	21	23	29	28	17	13	5	-5	-29
Silver Lake	15	-28	-30	-20	8	14	13	25	20	13	9	-32	-16	-32
The Dalles	35	-19	-19	-1	25	30	39	42	41	31	20	-2	-18	-19
Wamie	8	-25	-19	-3	18	25	29	32	28	19	21	11	-4	-25
Warspring	8	-32	-4	8	18	25	26	35	35	23	17	9	-8	-32

TABLE 6.—Average number of days with .01 inch or more of precipitation.

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	7	10	8	9	4	5	5	3	13	4	4	8	8	70
Crescent	4	12	13	12	6	8	8	5	12	4	6	8	12	93
Grass Valley	8	6	4	5	4	4	4	4	13	2	2	7	7	49
Heisler	3	7	6	9	4	6	6	4	12	2	2	4	9	61
Prineville	13	4	5	6	6	4	4	4	13	3	3	4	4	44
Silver Lake	14	4	5	5	3	4	4	4	13	3	3	5	5	67
Sisters	2	16	10	6	5	5	5	4	4	6	8	10	9	86
The Dalles	35	11	9	9	5	5	4	4	1	1	3	10	12	73
Wamie	8	10	7	7	3	3	3	1	2	2	4	9	7	66
Warspring	8	8	8	11	5	5	5	4	2	3	4	8	8	70

TABLE 7.—Average depth of snowfall.

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	7	13.5	9.0	8.0	1.2	0.3	0.0	0.0	0.0	0.0	0.0	3.1	10.8	45.9
Crescent	4	22.2	7.8	19.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	T.	18.5	52.4
Grass Valley	8	8.2	2.2	12.4	T.	T.	0.0	0.0	0.0	0.0	0.0	T.	6.4	21.3
Heisler	3	3.0	6.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T.	1.3	11.8
Prineville	13	3.3	5.8	12.6	T.	T.	0.0	0.0	0.0	0.0	0.0	T.	0.7	13.2
Silver Lake	14	5.7	5.9	4.4	3.2	0.4	T.	0.0	0.0	0.0	0.3	2.4	5.9	28.2
Sisters	2	10.6	4.0	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.2	17.5	3.0
The Dalles	35	13.2	8.0	1.1	T.	0.0	0.0	0.0	0.0	0.0	0.0	T.	11.2	3.0
Wamie	8	14.9	13.5	9.8	0.12	0.0	0.0	0.0	0.0	0.0	0.1	6.2	14.4	56.1
Warspring	8	9.7	5.1	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.8	24.2

TABLE 8.—Direction of prevailing wind.

Stations.	Length of record.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Bend	6	sw.	sw.	sw.	sw.	nw.	sw.	n.	sw.	sw.	sw.	sw.	sw.	sw.
Crescent	4	s.	s.	s.	s.	sw.	nw.	s.	sw.	sw.	n.	s.	s.	s.
Grass Valley	8	sw.	sw.	sw.	nw.	nw.	sw.	nw.	nw.	nw.	sw.	sw.	sw.	sw.
Heisler	4	s.	w.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.
Prineville	7	sw.	sw.	sw.	sw.	sw.	nw.	sw.	sw.	sw.	sw.	sw.	sw.	sw.
Silver Lake	15	sw.	sw.	sw.	sw.	sw.	sw.	sw.	w.	w.	sw.	sw.	sw.	sw.
Sisters														
The Dalles	35	e.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	e.	w.
Wamie	8	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.	w.
Warspring	8	sw.	sw.	nc.	sw.	w.	w.	nw.	nw.	nw.	nw.	sw.	nw.	nw.

WATER RESOURCES OF DESCHUTES RIVER DRAINAGE BASIN.

By J. C. STEVENS, District Engineer, United States Geological Survey.

Deschutes River has its source in a number of mountain lakes at the summit of the Cascades, just over the mountains from the headwaters of Willamette River, and its course is northward to the Columbia, which it enters about 15 miles above The Dalles.

The principal tributaries of Deschutes River are White, Warm-springs, Metolius, and Crooked rivers, and the West Fork of the Deschutes. All except Crooked River drain the eastern slope of the Cascades, which contributes the larger portion of the stream flow. The drainage area of the system is distributed somewhat as follows:

	Sq. miles.
Deschutes at Bend	1,530
Deschutes above the mouth of the Crooked River	2,520
Deschutes at Sherars Bridge	8,750
Deschutes River above Lava post-office (locally known as Little River)	720
Crooked River	2,920
East Fork of Deschutes River	200
West Fork of Deschutes River	500

Topographically, the area is rough and mountainous. The agricultural lands consist largely of high table lands cut by deep canyons through which the rivers flow, and small arable areas which border the streams. The soil is a coarse, disintegrated lava. The rocks of the entire area are volcanic and so peculiarly porous that the basin has an effect similar to that of a huge sponge. Deschutes River has perhaps the most remarkably uniform flow of any river comparable with it in size, and on this account its economic value is very great. At the mouth of the stream the maximum flow is six times, and at Bend only three times, the minimum. Ocular evidence of this uniformity of flow is presented by the low grass-grown banks between which the river flows throughout its upper course.